

REMARKS

This application has been amended in a manner that is believed to place it in condition for allowance at the time of the next Official Action.

Claims 16-36 are pending in the present application. Claims 16-18 have been amended to further characterize the dihydroxyethylene groups as being part of a 5- or 6-membered ring. Moreover, the oxidizing agent used to oxidize the dialdehyde has also been further characterized. Support for these changes may be found in the present specification at page 1, line 11 and claim 22. Claim 21 has been rewritten as an independent claim. Claims 32 and 33 have been amended in a similar manner to claims 16 and 18. New claims 34-36 have been added. Support for new claims 34-36 may be found in original claim 19 and generally throughout the specification.

In the outstanding Official Action, claims 16-19 and 30-33 were rejected under 35 USC §102(b) as allegedly being anticipated by LEROY et al. This rejection is respectfully traversed.

LEROY et al. describe oxidation of starch and starch derivatives with sodium hypobromite and sodium bromite. According to LEROY et al. this results in products having both carboxyl groups and carbonyl groups.

As the Examiner is aware, carbonyl groups comprise two major functional groups, i.e., ketone (keto) groups wherein the

carbonyl ($>\text{C}=\text{O}$) is bound to carbon atoms at both sides; and aldehyde groups wherein the carbonyl is bound to hydrogen at one side. These two groups are fundamentally different: aldehydes are much more reactive than ketones and aldehydes are also more susceptible to other reactions than ketones. For example, aldehydes can undergo oxidation (to form carboxyl groups) and are therefore unstable in the presence of oxidizing agents, while ketones cannot be oxidized (unless under very drastic conditions leading to breakdown of the whole molecule) and are therefore stable in the presence of most oxidizing agents. Also, there is a major difference in generation of keto vs. aldehyde groups: keto groups generally result from oxidation of secondary (chain) hydroxyl groups (according to the equation: $\text{C}-\text{CHOH}-\text{C}+\text{[O]}\rightarrow\text{C}-\text{CO}-\text{C}+\text{H}_2\text{O}$); while aldehydes generally result from oxidation of primary (terminal) hydroxyl groups (according to the equation: $\text{C}-\text{CH}_2\text{OH}+\text{[O]}\rightarrow\text{C}-\text{CHO}+\text{H}_2\text{O}$).

Moreover, it is known that oxidation of dihydroxyethylene groups (two adjacent secondary hydroxymethyl groups) in carbohydrates using sodium hypobromite and sodium hypochlorite leads to introduction of keto groups (but not aldehyde groups) and eventually to introduction of carboxyl groups. Applicants enclose a copy from a literature reference showing the generally accepted mechanisms for hypochlorite and hypobromite oxidations of carbohydrates (Whistler et al). The reaction on page 6462 shows the various steps from the

dihydroxyethylene group to two carboxyl groups, and that ketones occur at two instances (the first common intermediate from above having one keto group, and the second and third intermediate of the right-hand path having two keto groups and one keto group respectively). Aldehydes occur nowhere in this oxidation sequence.

The teaching of LEROY et al. is in full agreement with these explanations. LEROY et al. teach that oxidation of starch with sodium (hypo)bromite in less than stoichiometric amounts leads to carboxyl and carbonyl groups, just like the oxidation shown in the reaction scheme shown in the above reference. LEROY et al. fail to mention or suggest the generation of aldehyde functions in the starch units.

While LEROY et al. also refer to the oxidation of starch derivatives such as hydroxyalkyl starch ethers (see column 3, beginning at line 45), wherein aldehyde functions may arise in the side chain, i.e., in the hydroxyalkyl moiety, which is not a part of the (cyclic) starch units. Thus, LEROY et al. teach that aldehydes are formed on the terminal carbon of the side chain and keto groups are formed on other positions (column 3, lines 36-40). LEROY et al. do not disclose or suggest the introduction of aldehyde groups in the starch system itself, which would also be impossible in the process of LEROY et al., as explained above.

Further evidence that the process of LEROY et al. does not lead to aldehydes in the starch units is given in column 4,

lines 63-66, where it is stated that by sophisticated analysis no oxidation on the basic starch unit was found at all, and that only the (non-starch) side chain was oxidized.

As to the examples of LEROY et al. referred to by the Office Action, they do not specify the starch that was used. Indeed, there is no mention of aldehydes in the examples, only of carbonyls. As a result, these carbonyls (also mentioned in Table 1 and the other Tables of LEROY et al.), must therefore be keto groups.

Thus, in view of the above, applicants believe that LEROY et al. fail to anticipate or render obvious the claimed invention.

Claims 16 and 20 were rejected under 35 USC §102(b) as allegedly being anticipated by BATTISTA et al. This rejection is respectfully traversed.

BATTISTA et al. describe oxidation of cellulose with sodium hypochlorite (Examples 2-5). A mixed aldehyde- and carboxyl-containing derivative is prepared, but it is not stated what proportion of aldehyde groups was present, nor where the aldehyde groups are positioned. Regular hypochlorite oxidation of carbohydrates is known not to lead to intact molecules having aldehyde groups (see above; Figure 1). Indeed, the reaction conditions and the copper number of 27.6 of Example 2 point to the extensive breakdown of the cellulose.

It also is known that each cellulose molecule contains an aldehyde function at the glycosidic chain terminus. The extensive breakdown means more terminal aldehyde groups, which explains the aldehyde content as stated. There is no indication, nor is it conceivable, that the product contains any aldehyde groups at the positions of the original 1,2-dihydroxyethylene groups of the cyclic starch units.

BATTISTA et al. also describe oxidation of cellulose (not dialdehyde cellulose) with potassium dichromate or potassium permanganate (Examples 8 and 9, respectively), also said to lead to a mixed aldehyde- and carboxyl-containing derivative. Here again, the harsh conditions (strong acid) and the known non-selective activity of the oxidants used are indicative of extensive breakdown and the likelihood of oxidation of positions other than the dihydroxyethylene groups. Thus, no indication of the proportion of the aldehydes is given. As a result, applicants believe that BATTISTA et al. fail to disclose or suggest the claimed invention.

As the claims recite the products having the aldehyde groups on the positions of the dihydroxyethylene groups of the carbohydrate units, these are the 2- and 3-positions of the cyclic basic monomer units. As explained above, neither LEROY et al. nor BATTISTA et al. disclose or suggest a carbohydrate product (starch or cellulose or other) having aldehyde groups on these positions, nor do the publications teach the specification

of the oxidizing agent (molecular halogen in catalytic amounts) used in the oxidation of the intermediate distinguishes from any oxidizing agent taught by either LEROY et al. or BATTISTA et al.

Thus, BATTISTA et al. and LEROY et al. fail to anticipate or render obvious the claimed invention.

In view of the present amendment and the foregoing remarks, therefore, applicants believe that the present application is in condition for allowance at the time of the next Official Action. Allowance and passage to issue on that basis is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. §1.16 or under 37 C.F.R. §1.17.

Respectfully submitted,

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Appendix:

The Appendix includes the following item:

- Whistler et al., J. Amer. Chem. Soc. 79 (1957) 6460-6464